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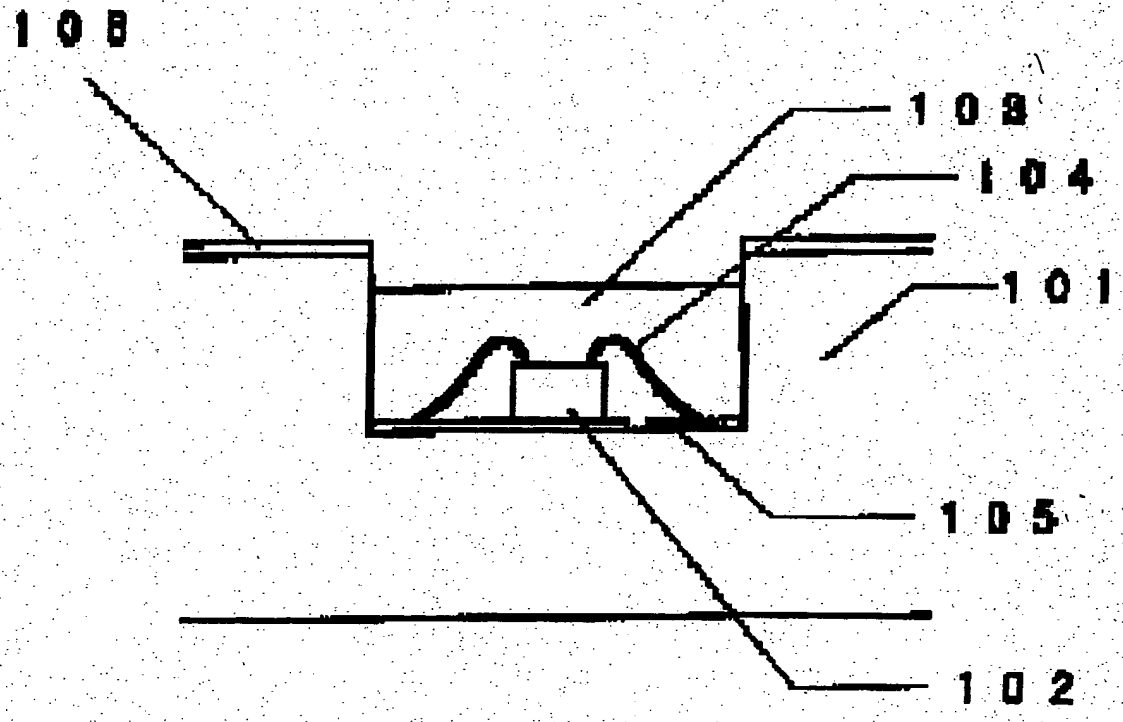
PN - JP10107322 A 19980424
PA - NICHIA KAGAKU KOGYO KK
PD - 1998-04-24
PR - JP19960257206 19960930
OPD - 1996-09-30
TI - LED DISPLAY
IN - NAGAMINE KUNIHIRO; IZUNO KUNIHIRO
ICO - T01L33/00B7
EC - H01L33/00B3B
IC - H01L33/00

PN - JP10107322 A 19980424 DW199827 H01L33/00 008pp
PA - (NICH-N) NICHIA KAGAKU KOGYO KK
TI - Structure of LED indicator used in indoor-outdoor display boards, large sized video apparatus - has substrate made of specific [redacted] and [redacted] with concave opening, which is closed by coating member containing specific elements
PR - JP19960257206 19960930
IC - H01L33/00
AB - J10107322 The structure includes a substrate (101), on which a conductor wiring (104) and set of concave openings are formed. A LED chip (102) containing gallium-nitride group compound semiconductor is electrically connected with the wirings through the openings.
- The openings are sealed with a coating member (103) containing a specific fluorescent material. The substrate is made of specific [redacted] and [redacted] along with [redacted] filler consisting of heat resistant organic resin. The coating member includes elements like yttrium, gadolinium and lanthanum.
- ADVANTAGE - Improves angle of visibility. Simplifies manufacture. Increases directional characteristic.
- (Dwg.1/3)
OPD - 1996-09-30
AN - 1998-303806 [27]

PN - JP10107322 A 19980424
PA - NICHIA CHEM IND LTD
PD - 1998-04-24
AP - JP19960257206 19960930
IN - NAGAMINE KUNIHIRO;IZUNO KUNIHIRO
TI - LED DISPLAY
AB - PROBLEM TO BE SOLVED: To achieve an improved fineness and a high visual field angle, improve reliability, and make an LED display thin by arranging a conductor wire and selecting a substrate with a plurality of recessed openings from [redacted], a [redacted] substrate, and a heat-resistance organic resin with a [redacted] filler.

- LUTION: A substrate 101 has a conductor wiring layer 105 where, for example, an electrical connection member such as an LED chip 102 and a conductive wire 104 and a plurality of recessed openings that contain a fluorescent substance are provided. A substrate with the conductor wiring layer 105 with the recessed openings preferably has an improved adhesion property with, for example, a coating part 103 that contains a fluorescent with improved heat radiation property. As a wiring substrate material with the recessed openings, a [redacted] substrate, a [redacted] substrate with a conductor wiring layer via an insulation layer, based on a [redacted] and a heat-resistance organic resin substrate with a [redacted] filler are listed. Especially, a [redacted] substrate mainly consisting of [redacted] is preferable, in terms of heat radiation property and weather resistance.

- H01L33/00



[Detailed Description of the Invention]

[0001]

[Field of the Invention] The invention in this application relates to the LED drop which has especially the light-emitting part with which a white system can emit light with high definition about the light source and the drop of a display and a line sensor which can display various data.

[0002]

[Description of the Prior Art] The LED chip which can emit light in the super-high brightness which also attains to 1000mcd(s) in RGB (a red system, a green system, blue system) was developed today, respectively. In connection with this, the LED drop which indicates by full color by carrying out color mixture luminescence using each LED chip with which a red system (R), a green system (G), and a blue system (B) can emit light is being installed. Other than large-scale image equipment using the full color type as an example of the purpose of use of such an LED drop, there is a character representation plate in indoor and the outdoors etc. Like drawing 3 , the LED chip with which RGB can emit light is arranged in the cup of a mounting lead, respectively, and, specifically, each LED chip and an inner lead are electrically connected using a conductive wire etc., respectively. Moreover, the LED lamp is constituted by making a part of each LED chip, conductive wire, and leadframe [at least] cover with mold resin. When making an LED drop constitute using such an LED lamp, it mounts in a printed wired board in the shape of a dot matrix etc., and is formed by connecting using the LED drive circuit board, a contact pin, or a connector. When such an LED indicator makes each LED chip in an LED lamp emit light, respectively, a white system can emit light.

[0003]

[Problem(s) to be Solved by the Invention] However, although an LED chip has the outstanding monochromatic peak wavelength, it makes each LED chip drive also in the display for black and white on which only a reason and a white display are displayed, and cannot obtain a colander. Moreover, in order to arrange each LED chip and to take electrical installation, the LED lamp on a substrate needs a certain amount of magnitude.

Furthermore, in order to raise the color mixture nature of RGB, it may not be enough just to bring an LED chip close. In order to raise color mixture nature, the mold member which gave the lens effectiveness needed to be used. Therefore, there is a limitation in the miniaturization using an LED lamp of an LED drop.

[0004] Therefore, it is restricted to the single diameter of an LED lamp (3-5phi) by which the LED lamp of RGB etc. has been arranged at the high minute display application, and reduction of a dot pitch is difficult. For example, it will be the display of the shape of a matrix which has 16x16 dots, and even if it uses the LED lamp of 5phi, now, production of dot pitchmm [about 6mm] about 96mm angle display board will be a limitation.

[0005] In addition, with LED lamp structure with a leadframe, since a through tube is needed for a printed circuit board at the time of mounting, the problem that the complexity of the wiring design accompanying reduction of a substrate wiring field and arrangement of a contact pin or a connector become difficult arises. Furthermore, since lamp height is set to 10-15mm in the shape of LED ramp type, it is difficult to make thickness of the display section thin. Moreover, the directional characteristics of the light source are restricted by the lens configuration of an LED lamp, and it may be unsuitable as a display application of a high angle of visibility (for example, **30 half power angles etc.).

[0006] In the case of the surface mount mold LED (it is also hereafter called the chip type LED.), appearance size can be made a little smaller than the shell mold lamp LED etc. However, spacing of the LED chips which adjoin arranging a large number in consideration of surface mount equipment or a repair process is needed in the same field. Therefore, also with the surface mount mold LED, when making the LED chip of RGB load, high density loading becomes difficult.

[0007] Furthermore, the high-density-assembly LED drop using the LED chip with which RGB3 color can emit light is not enough respectively only at the heat dissipation from the leadframe of an LED lamp etc. Therefore, the heat dissipation from a substrate is needed and it is thought by the printed wired board that it is difficult. therefore, the thing to which the invention in this application solves the above-mentioned technical problem -- it is -- high -- minute -- a high angle of visibility and high-reliability -- a thin shape -- it aims at offering the LED drop [-izing / a drop].

[0008]

[Means for Solving the Problem] the invention in this application -- a conductor -- the substrate which arranges wiring and has two or more concave openings, and these concave opening circles -- said conductor -- with the LED chip which has the gallium nitride system compound semiconductor electrically connected with wiring in a luminous layer It is the LED drop which closed said concave opening circles by the coating member which has a 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce fluorescent material. Said substrates are the ceramics, a metal substrate, and the LED drop characterized by being one chosen from the thermal-resistance organic resin containing a thermally conductive filler. (However, 0<=x<1, 0<=y<=1, and RE are a kind of elements chosen from the group which consists of Y, Gd, and La at least.)

[0009]

[Function] the conductor which the invention in this application excelled [conductor] the LED chip which has the gallium nitride system compound semiconductor in which blue system luminescence is possible, and the 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce fluorescent material in heat dissipation nature, and approached and prepared two or more concave openings -- the case where it is made to arrange on the substrate which has a wiring layer -- also setting -- more -- a high minute one -- high -- it can consider as the LED drop with which an angle of visibility white system can emit light.

[0010]

[Embodiment of the Invention] an invention-in-this-application person chooses a semi-conductor light emitting device, a specific fluorescent material, and a specific matrix substrate as a result of various experiments -- color mixture nature -- good -- quantity -- it came to accomplish the header invention in this application for the ability to consider as the LED drop in which white system luminescence is possible minute.

[0011] Namely, an LED chip and the fluorescent material excited by the light from this LED chip, When allotting the substrate which has opening which approached two or more, an LED chip A gallium nitride system semi-conductor, A fluorescent material 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce, setting the substrate which has two or more concave openings to one chosen from the ceramics, a metal substrate, and the thermal-resistance organic resin containing a thermally conductive filler -- color mixture nature --

good -- quantity -- it considers as the LED drop in which white system luminescence is possible minute.

[0012] Luminescence of a blue system is possible for an LED chip in high brightness. Luminescence which has the luminescent color, complementary color relation, etc. with sufficient lightfastness from an LED chip under a high exposure efficiently by luminescence from an LED chip is possible for a fluorescent material. moreover, a substrate -- an LED chip and a fluorescent material -- quantity -- while being able to arrange minute, having which efficient description that can be emitted outside is called for in the heat from an LED chip. By considering as the configuration of the invention in this application which fulfills these conditions, a dot pitch can consider as an LED drop with very few falls of a color gap or luminescence brightness by 2mm under super-high density to which the diameter of opening results in about 1.5mm.

[0013] As a concrete example, LED display equipment is shown in drawing 1 . The light-emitting part is made to have fixed the LED chip which used the gallium nitride system semi-conductor using an epoxy resin etc. in opening arranged in the shape of [of a ceramic substrate] a dot matrix. As a conductive wire, a gold streak is looked like [each electrode of an LED chip, and the gold plate pattern formed on the ceramic substrate], and is connected electrically, respectively. (RE1-xSmX) What carried out mixed distribution of the 3(aluminum1-yGay)5O12:Ce fluorescent material into silicone rubber is made to pour in, and homogeneity is made to carry out hardening formation. Light can be made to emit by making such an LED drop supply power. A white system etc. can emit light with color mixture with luminescence from the fluorescent material with which these luminescence was excited by luminescence from an LED chip, and its luminescence. Hereafter, the configuration member of the invention in this application is explained in full detail.

[0014] (Substrate 101) the conductor which prepared two or more concave openings which make an electrical installation member etc. and fluorescent materials, such as the LED chip 102 and the conductive wire 104, contain as a substrate 101 used for the invention in this application -- it has a wiring layer 105. If high density assembly of two or more LED chips is carried out on a direct same substrate, the heat release from an LED chip will increase. If heat cannot be enough radiated in the heat from this LED chip and

(RE1-xSmX) homogeneity is not made to distribute a 3(aluminum1-yGay)5O12:Ce fluorescent material in resin, degradation of the partial crack of the coating section, coloring, etc. may be produced.

[0015] therefore, the conductor which prepared concave opening used for the invention in this application -- it is desired for adhesion with the coating section 103 which heat dissipation nature was [section] excellent and made the fluorescent material contain as a substrate which has a wiring layer 105 to be good. as the wiring substrate ingredient which has such concave opening -- a ceramic substrate and a metal -- the base -- carrying out -- an insulating layer -- minding -- a conductor -- the metal substrate and the thermal-resistance organic resin substrate containing a thermally conductive filler which have a wiring layer are mentioned. The LED drop which these substrates can form concave opening and a wiring member with the same ingredient, and concave opening and the wiring section unified by resin molding with press working of sheet metal and an organic resin substrate at the ceramic substrate can be made to form simply in the laminating of a hole aperture substrate, and a metal substrate.

[0016] The ceramic substrate mainly especially concerned with the alumina in the point of heat dissipation nature or weatherability is more desirable. 90 - 96% of the weight of raw material powder is specifically an alumina. As sintering acid Viscosity, The ceramic substrate which talc, a magnesia, calcia, a silica, etc. are added four to 10% of the weight, and was made to sinter in a 1500 to 1700-degree C temperature requirement, 40 - 60% of the weight of ****** powder is the ceramic substrate which 60 - 40% of the weight of borosilicate glass, a KOJU light, forsterite, a mullite, etc. are added as sintering acid with an alumina, and was made to sinter in the temperature requirement which is 800-1200 degrees C.

[0017] Such a substrate can take configurations various in the green sheet phase before baking. Wiring 105 can be made to constitute by carrying out screen-stencil etc. to a desired configuration on a green sheet etc. by using as a circuit pattern the thing which made the resin binder contain refractory metals, such as a tungsten and molybdenum. Moreover, opening which makes an LED chip and a fluorescent material contain can also be made to form freely by making the green sheet which carried out opening rival in a multilayer etc. Therefore, it is also possible to form a stair-like opening side attachment

wall etc. by carrying out the laminating of the green sheet with which the shape of a cylinder differs from an aperture. A ceramic substrate is obtained by making such a green sheet sinter. Moreover, it may be made to paste up and you may use, after making each sinter.

[0018] Moreover, only the substrate front face 106 formed by making the green sheet on the front face of the maximum contain Cr 2O3, MnO2, TiO2, Fe 2O3, etc. in the green sheet itself can be made into a dark color system. The substrate with such a maximum front face also becomes contrast improving and highlighting luminescence of an LED chip or a fluorescent material more.

[0019] The side attachment wall which spread toward opening can raise the further reflection factor. In order that the side-attachment-wall configuration of concave opening may avoid loss of luminescence from an LED chip, the shape of a taper angle, a curved surface, or a stairway on the straight line which was optically suitable for reflection is mentioned. Moreover, the depth of concave opening is decided with the include angle in the range which does not cover the direct solar radiation from an LED chip while it prevents that the slurry which distributed the fluorescent material flows out. Therefore, the depth of concave opening has 0.3 desirablemm or more, and 0.5mm or more its less than 2.0mm is more desirable.

[0020] Concave opening of a substrate arranges an LED chip and a fluorescent material inside. Therefore, while direct loading etc. carries out an LED chip by a die bond device etc., there should just be sufficient magnitude which can take electrical installation with an LED chip by wire bonding etc. Two or more concave openings can be prepared according to a request, and can make the shape of a dot matrix or a straight line etc. of 16x16 or 24x24 choose variously. the dot pitch of concave opening -- quantity 4mm or less -- when minute, as compared with the case where a shell mold LED lamp is carried, the dot pitch should contract sharply moreover, such [in the configuration of the invention in this application] quantity -- even if it sets minute, it becomes the especially excellent high density LED display equipment which can solve the various problems relevant to the heat dissipation nature from an LED chip. Thermosetting resin etc. can perform adhesion with an LED chip and a substrate pars basilaris ossis occipitalis. Specifically, an epoxy resin, acrylic resin, imide resin, etc. are mentioned. Moreover,

while making it paste up with wiring prepared in the substrate with a face down LED chip etc., in order to make it connect electrically, Ag paste, an ITO paste, carbon paste, a metal bump, etc. can be used. Moreover, in order to raise conductivity, the reflection factor of the substrate pars basilaris ossis occipitalis on which an LED chip and a fluorescent material are arranged, etc., vacuum evaporationo, plating processing, etc. can be performed to wiring formed on the substrate, and silver, gold, copper, platinum, and these alloys can also be made to form in it.

[0021] (Fluorescent material) The fluorescent material which is excited as a fluorescent material used for the invention in this application by the light and ultraviolet rays which emitted light from the semi-conductor luminous layer, and emits light is said. As a concrete fluorescent material, it is a 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce fluorescent material (however, at least a kind of element chosen from the group which 0<=x<1, 0<=y<=1, and RE become from Y, Gd, and La). When the light which emitted light from the LED chip using a gallium nitride system compound semiconductor, and the light which emits light from a fluorescent material have a complementary color relation etc., if luminescence from an LED chip and the luminescence from a fluorescent material are indicated by color mixture, the luminescent color display of a white system can be performed. In order to make concave opening fill up with a fluorescent material, it can form by making it thin to extent which is made to contain the fine particles of a fluorescent material etc. in resin or glass, and the light from an LED chip penetrates. The color tones of arbitration, such as an electric bulb color, including a white system with a high color temperature can be made to offer by choosing adjusting various ratios of a fluorescent material, resin, etc., and spreading and fills, and the luminescence wavelength of a light emitting device.

[0022] Furthermore, content distribution of a fluorescent material also influences color mixture nature and endurance. That is, it is easy to control degradation by moisture that it is harder to be influenced of the moisture from an external environment etc. toward an LED chip by the front-face side of concave opening which the fluorescent material contained when the distribution concentration of a fluorescent material is high. On the other hand, if distribution concentration becomes high toward an LED chip to a concave opening front-face side about content distribution of a fluorescent material, although it

will be easy to be influenced of the moisture from an external environment, the effect of generation of heat from an LED chip, exposure reinforcement, etc. can control degradation of a fluorescent material fewer. Such distribution of a fluorescent material can be made to form variously by making the member containing a fluorescent material, formation temperature, viscosity, the configuration of a fluorescent material, particle size distribution, etc. adjust. Therefore, various distribution concentration of a fluorescent material can be chosen according to a service condition etc.

[0023] Or especially the fluorescent material of the invention in this application touches an LED chip, it approaches, and it is arranged and it can perform thing sufficient efficient to ******** also in -two or less -two or more (Ee) =3 W-cm10 W-cm as irradiance.

[0024] The fluorescent material used for the invention in this application can be strong for heat, light, and moisture, and the peak of an excitation spectrum can make it carry out near 450nm etc. for garnet structure. Moreover, it has the broadcloth emission spectrum with which the main luminescence peak is also near 530nm, and lengthens the skirt to 700nm. And luminescence wavelength shifts to long wavelength in luminescence wavelength shifting to short wavelength in permuting a part of aluminum of a presentation by Ga, and permuting a part of Y of a presentation by Gd. Thus, it is possible to adjust the luminescent color continuously by changing a presentation. therefore, a long wave -- it has the ideal conditions for changing blue system luminescence of a nitride semi-conductor -- the reinforcement by the side of merit is continuously changed by the presentation ratio of Gd -- into white system luminescence.

[0025] Moreover, optical effectiveness can be further raised by having an LED chip using a gallium nitride system semi-conductor, and the fluorescent material which made the yttrium aluminum garnet fluorescent material (YAG) activated with the cerium contain the samarium (Sm) of rare earth elements.

[0026] An oxide or the compound which turns into an oxide easily at an elevated temperature is used for such a fluorescent material as a raw material of Y, Gd, Ce, Sm, aluminum, La, and Ga, it fully mixes them by stoichiometry, and obtains a raw material. Or the coprecipitation oxide which calcinates what coprecipitated the solution which dissolved the rare earth elements of Y, Gd, Ce, Sm, and La in the acid by stoichiometry with oxalic acid, and is obtained, and an aluminum oxide and an oxidation gallium are

mixed, and a mixed raw material is obtained. It can obtain by carrying out optimum dose mixing of the fluorides, such as ammonium fluoride, as flux at this, stuffing crucible, calcinating in the temperature requirement of 1350-1450-degreeC in air for 2 to 5 hours, obtaining a burned product, then carrying out the ball mill of the burned product underwater, and letting a screen pass at washing, separation, desiccation, and the last.

[0027] (Y1-p-q-rGdpCeqSmr) 5O3aluminum12 fluorescent material contains Gd during a crystal -- especially -- a long wave 460nm or more -- excitation luminous efficiency of a long region can be made high. By the increment in the content of a gadolinium, an emission peak wavelength moves to long wavelength from 530nm to 570nm, and also shifts the whole luminescence wavelength to a long wavelength side. When the strong luminescent color of redness is required, the amount of permutations of Gd can be attained by making [many] it. On the other hand, while Gd increases, the luminescence brightness of photo luminescence by blue glow falls gradually. Therefore, as for p, it is desirable that it is 0.8 or less, and it is more desirable that it is 0.7 or less. It is 0.6 or less still more preferably.

[0028] 5O3(Y1-p-q-rGdpCeqSmr) aluminum12 fluorescent material containing Sm is not concerned with the increment in the content of Gd, but there are few falls of the temperature characteristic. Thus, by making Sm contain, the luminescence brightness of the fluorescent material in high temperature improves sharply. The extent improved becomes so large that the content of Gd becomes high. That is, it turned out that the presentation which increased Gd and gave redness to the luminescent color tone of a fluorescent material is effective for the temperature characteristic improvement by content of Sm. (In addition, it expresses with the relative value (%) of the hot (200-degreeC) luminescence brightness of this fluorescent material to the excitation luminescence brightness in the ordinary temperature (25-degreeC) by 450nm blue glow the temperature characteristic here.)

[0029] The content of Sm becomes 60% or more and has the desirable temperature characteristic in 0.0003<=r<=0.08. If r is smaller than this range, the effectiveness of temperature characteristic amelioration will become small. Moreover, if r becomes large from this range, the temperature characteristic will fall conversely. In 0.0007<=r<=0.02, the temperature characteristic becomes 80% or more, and is the most desirable.

[0030] As for Ce, relative luminescence brightness becomes 70% or more in 0.003<=q<=0.2. Or less in 0.003, if a brightness fall is carried out and it becomes large from 0.2 conversely because the number of the excitation emission centers of photo luminescence according [q] to Ce decreases, concentration quenching will arise.

[0031] In the invention in this application, two or more kinds of such fluorescent materials may be mixed. That is, two or more kinds of 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce fluorescent materials with which the contents of aluminum, Ga, Y, La and Gd, or Sm differ can be mixed, and the wavelength component of RGB can be increased. It can consider as an LED drop with color purity high thereby more.

[0032] (LED chip 102) In the LED chip 102 used for the invention in this application, it is the nitride system compound semiconductor which can excite efficiently a 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce fluorescent material. the LED chip which is a light emitting device -- MOCVD -- semi-conductors, such as InGaN, are made to form as a luminous layer on a substrate by law etc. As structure of a semi-conductor, the thing of a terrorism configuration is mentioned to the gay structure, hetero structure, or double which has MIS junction, PIN junction, a PN junction, etc. Various luminescence wavelength can be chosen by whenever [ingredient or its mixed-crystal]. [of a semi-conductor layer] Moreover, it can also consider as the single quantum well structure and multiplex quantum well structure where the semi-conductor barrier layer was made to form in the thin film which the quantum effectiveness produces.

[0033] When a gallium nitride system compound semiconductor is used, ingredients, such as sapphire, a spinel, and SiC, Si, ZnO, are used for a semi-conductor substrate. In order to make crystalline good gallium nitride form, it is desirable to use a sapphire substrate. Buffer layers, such as GaN and AlN, are formed on this sapphire substrate, and the gallium nitride semi-conductor which has a PN junction is made to form on it. A gallium nitride system semi-conductor shows N type conductivity in the condition of not doping an impurity. When making the N type gallium nitride semi-conductor of a request, such as raising luminous efficiency, form, it is desirable to introduce Si, germanium, Se, Te, C, etc. suitably as an N type dopant. On the other hand, when making a P type gallium nitride semi-conductor form, Zn, Mg, Be, calcium, Sr, Ba, etc. which are P type DOPANDO are made to dope. Only by doping a p-type dopant, since itis [P-type-

] hard toize a gallium nitride system compound semiconductor, it is desirable to make it P-type-ize by annealing after p-type dopant installation by heating, the low-speed electron beam irradiation, the plasma exposure, etc. at a furnace. After making the exposure of a P-type semiconductor and an N-type semiconductor form by etching etc., the sputtering method, a vacuum deposition method, etc. are used and each electrode of a desired configuration is made to form on a semi-conductor layer.

[0034] Next, after carrying out direct full cutting with the dicing saw with which the blade which has the edge of a blade made from a diamond rotates the formed semi-conductor wafer or cutting the slot of width of face larger than edge-of-a-blade width of face deeply (half cutting), a semi-conductor wafer is broken according to external force. or the scriber in which the diamond stylus at a tip carries out both-way rectilinear motion -- a scribe line (circles of longitude) very thin to a semi-conductor wafer -- for example, after lengthening in a grid pattern, according to external force, a wafer is broken and it cuts in the shape of a chip from a semi-conductor wafer. Thus, the LED chip which is a gallium nitride system compound semiconductor can be made to form.

[0035] When making a white system emit light in the invention in this application, in consideration of complementary color relation with a fluorescent material, resin degradation, etc., the luminescence wavelength of a light emitting device has 400nm or more desirable 530nm or less, and 420nm or more 490nm or less is more desirable. In order to raise the effectiveness of an LED chip and a fluorescent material more, respectively, 450nm or more 475nm or less is still more desirable. The example of an emission spectrum of the invention in this application is shown in drawing 2 . Luminescence which has a peak near 450nm is luminescence from an LED chip, and luminescence which has a peak near 570nm is luminescence of the fluorescent material excited with an LED chip.

[0036] (Coating member 103) The fluorescent material which changes luminescence of the LED chip 102 contains the coating member 103. As a concrete ingredient of the binder which constitutes a coating member, transparence resin, glass, etc. excellent in weatherability, such as an epoxy resin, a urea resin, and silicone, are used suitably. When an LED chip is arranged to high density, it is more desirable to use an epoxy resin, silicone resin, those combined things in consideration of an open circuit of the conductive

wire by the thermal shock etc. Moreover, in order to increase an angle of visibility further, a dispersing agent may be made to contain, although the fluorescent material itself has dispersion nature. As a concrete dispersing agent, barium titanate, titanium oxide, an aluminum oxide, oxidation silicon, etc. are used suitably.

[0037] (Conductive wire 104) As a conductive wire 104, it is one sort of the electrical installation member to which the electrode of the LED chip 102 and wiring of a substrate are connected, and what has ohmic nature, mechanical-connections nature, good electrical conductivity, and good thermal conductivity is called for. As thermal conductivity, more than 0.01 cal/cm2/cm/degree C is desirable, and it is more than 0.5 cal/cm2/cm/degree C more preferably. Moreover, in consideration of workability etc., the diameters of a conductive wire are more than phi10micrometer and less than [phi45micrometer] preferably. Specifically, the conductive wire using metals and those alloys, such as gold, copper, platinum, and aluminum, as such a conductive wire is mentioned. Such a conductive wire can connect easily the conductive pattern prepared in the substrate by the wire-bonding device to the electrode of each LED chip.

[0038] (Display) It can consider as the LED display equipment for black and white by connecting the LED drop of the invention in this application to a driving means. The LED indicator for black ahd white arranges concave opening which has an LED chip and a fluorescent material inside in the shape of a matrix etc., and constitutes it. An LED chip is electrically connected to the lighting circuit which is a drive circuit through the external terminal of an LED drop. It can consider as the display which can display various images by the output pulse from a drive circuit. It is switched with the output signal of the gradation control circuit which calculates the gradation signal for making predetermined brightness turn on a light-emitting part from the data memorized by RAM (Random, Access, Memory) and RAM which make the indicative data inputted memorize temporarily as a drive circuit, and a gradation control circuit, and has the driver which makes a light-emitting part turn on. A gradation control circuit calculates the lighting time amount of a light-emitting part from the data memorized by RAM, and outputs a pulse signal.

[0039] Therefore, the LED display equipment for black and white can carry out [highly minute]-izing while being able to simplify circuitry naturally unlike the full color drop

using each LED chip of RGB. Therefore, it can consider as a display without the irregular color accompanying the semi-conductor properties of each LED chip of RGB differing etc. Moreover, since it becomes the white system light source while the light from an LED chip is scattered about with a fluorescent material, compared with red and the LED drop using a green chisel, the stimulus to human being's eyes is suitable for use of long duration few. Moreover, when luminescence from that a fluorescent material emits light isotropic and an LED chip is scattered about with a fluorescent material, an angle of visibility becomes large. Hereafter, the concrete example of the invention in this application is explained in full detail.

[0040]

[Example]

(Example 1) The ceramic substrate was used as a wiring substrate which has concave opening in the shape of a dot matrix. the hole concave opening does not have [hole] a wiring layer at the time of ceramic substrate manufacture -- the aperture green sheet was made to form by carrying out a laminating The wiring layer was made to form by making a desired configuration screen-stencil a tungsten content binder. You make it pile up each of each other's green sheet, and it is made to have formed. In addition, the green sheet equivalent to a surface layer 106 is made to have contained chrome oxide for the improvement in contrast of a substrate. The ceramic substrate was made to constitute by making this sinter. The dot pitch of concave opening laid the commonness corresponding to a dot matrix in a wiring layer, and a signal line using 2.0mm, an opening depth of 1.0mm, and the ceramic substrate of the overall-length the angle of 32mm of 16x16 dots, and the front face has performed nickel/Ag plating. The ejection of the signal line from a ceramic substrate formed the contact pin by metal covar by silver solder connection.

[0041] Moreover, the GaInN semi-conductor whose main luminescence peak is 450nm was used as an LED chip which is a semi-conductor light emitting device. the sapphire substrate top which made the LED chip wash -- TMG (trimethylgallium) gas, TMI (trimethyl in JUUMU) gas, nitrogen gas, and dopant gas -- carrier gas -- a sink and MOCVD -- it was made to form by making a gallium nitride system compound semiconductor form by law The gallium nitride semi-conductor which has N type conductivity, and the gallium nitride semi-conductor which has P type conductivity were

formed, and the PN junction was made to form by changing SiH4 and Cp2Mg as dopant gas. (In addition, annealing of the P-type semiconductor has been carried out above 400 degrees C after membrane formation.)

[0042] After exposing PN each semi-conductor front face by etching, each electrode was made to form by the sputtering method, respectively. In this way, after lengthening a scribe line, external force was made to divide the done semi-conductor wafer, and the LED chip was made to form as a light emitting device. The LED chip with which this blue system can emit light was made to fix to the predetermined location in substrate opening according to heat curing after die bonding with an epoxy resin. Electrical installation was taken by carrying out wire bonding of the 25-micrometer gold streak to each electrode of an LED chip, and wiring on a substrate after that.

[0043] On the other hand, the fluorescent material carried out coprecipitation of the solution which dissolved the rare earth elements of Y, Gd, and Ce in the acid by stoichiometry with oxalic acid. The coprecipitation oxide which calcinates this and is obtained, and an aluminum oxide are mixed, and a mixed raw material is obtained. Ammonium fluoride was mixed as flux to this, crucible was stuffed, it calcinated at the temperature of 1400-degreeC in air for 3 hours, and the burned product was obtained. The ball mill of the burned product was carried out underwater, and it was made to form in washing, separation, desiccation, and the last through a screen. The 3(Y0.5Gd0.5) aluminum5O12:Ce fluorescent material 80 weight section and the silicone rubber 90 weight section which were formed were often mixed, and it considered as the thriller. An LED chip is arranged and this thriller was made to pour into the concave opening circles of the ceramic substrate of 16x16, respectively. The resin which the fluorescent material contained was stiffened in 130-degree-C 1 hour, and the LED drop was made to form after impregnation. The thickness of the LED drop at this time had only the thickness of 2.0mm of a ceramic substrate, and large thin-shape-izing was possible for it as compared with the display unit of shell mold LED lamp use.

[0044] The driving means of CPU equipped with the driver which it is switched [driver] with the output signal of the gradation control circuit which calculates the gradation signal for making predetermined brightness turn on light emitting diode from the data memorized by RAM (Random, Access, Memory) and RAM which make the indicative

data inputted as this LED indicator memorize temporarily, and a gradation control circuit, and makes light emitting diode turn on was connected electrically, and the LED display equipment was constituted.

[0045] In this way, the average chromaticity point at the time of making all the LED drops with which the obtained white system can emit light turn on, the color temperature, and the color-rendering-properties characteristic were measured, respectively. Respectively, it is a chromaticity point (the engine performance near x= 0.302, y= 0.291, color temperature 8085K, and Ra(color-rendering-properties characteristic) =87.3 and a three-wave mold fluorescent lamp was shown.). Moreover, change was not observed when 60mA energization per LED chip was carried out in the temperature of 25 degrees C for 100 hours as life test. At this time, it was checked that the rear-face side of a SERAMISSUKU substrate near the light-emitting part does not almost have a temperature gradient, and heat can be radiated efficiently. Since the thermal conductivity of a ceramic substrate was good, it has also checked the cure against heat dissipation from an LED component, and that it could carry out easily by radiation-fin wearing or forced-air cooling. Moreover, the yield of the invention in this application was higher than the thing which made the LED drop constitute from an LED lamp. In the case of an LED lamp, this has the low mounting dependability accompanied by poor soldering. However, by the invention in this application, it thinks because mounting dependability was high for connection by wire bonding.

[0046] (Example 2) instead of [of the ceramic substrate which has concave opening] -- a metal -- the base -- carrying out -- an insulating layer -- minding -- a conductor -- the LED drop was made to constitute like an example 1 except having used the metal substrate which has a wiring layer It checked that a metal substrate could be formed in the straight-line-like taper to which the reflection factor from an LED chip is not reduced by press forming or the side-attachment-wall configuration which has a curved surface, and freedom.

[0047]

[Effect of the Invention] The fluorescent material with which the invention in this application is excited by the light from an LED chip and this LED chip so that clearly from the above explanation, When allotting the substrate which has opening which

approached two or more, an LED chip A gallium nitride system semi-conductor, By setting the substrate which has 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce and two or more concave openings for a fluorescent material to one chosen from the ceramics, a metal substrate, and the thermal-resistance organic resin containing a thermally conductive filler the high angle of visibility which is not in the former -- thin-shape-izing and quantity -- it can consider as the white system LED drop which can form the dot-matrix structure below minute 4mm dot (for example, 2mm pitch). Moreover, the directional characteristics of an LED chip become usable as it is, and manufacture of the high angle-of-visibility LED display equipment of a **60-degree half power angle is possible.

[Claim(s)]

[Claim 1] a conductor -- the substrate which arranges wiring and has two or more concave openings, and these concave opening circles -- said conductor -- with the LED chip which has the gallium nitride system compound semiconductor electrically connected with wiring in a luminous layer It is the LED drop which closed said concave opening circles by the coating member which has a 3(RE1-xSmX) (aluminum1-yGay)5O12:Ce fluorescent material. The LED drop with which it was characterized by being one as which said substrate is chosen from the ceramics, a metal substrate, and the thermal-resistance organic resin containing a thermally conductive filler. However, 0<=x<1, 0<=y<=1, and RE are a kind of elements chosen from the group which consists of Y, Gd, and La at least.